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ABSTRACT

The curriculum and planning guide has two objectives: to give the instructor, planner, and counselor a guide which furnishes current information on the trade, facility planning, equipment, and resource information for all levels of occupational instruction in the field of auto mechanics maintenance and repair; and to enable the student to be employed in the occupation. The introduction discusses the trend away from programs and facilities designed around the use of cars as the sole educational system to the planning of more flexible-use spaces for free-standing engines, transmissions, chassis assemblies, and hydraulic systems, whether they are for automobiles, airplanes, or snowmobiles. In the new mechanics programs the mechanics simulator, trainer, and mock-up areas of the laboratory should represent as much as 70 percent of the student stations to provide skills required to tune-up and repair all types of engines. A table for planning space requirements for a vehicle maintenance cluster is included. The remainder of the guide is in the form of outlines under seven headings: suggested orientation course outline; skill development, chassis, and engine mechanics outline; skill development, auto body mechanics; automotive technology; tools and facility planning; reference materials; and instructional aids for auto mechanics. (Author/NH)

Suggested Curriculum and Planning Guide

for DEVELOPING a PROGRAM

in

AUTO MECHANICS

ED101058

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INTRODUCTION

Unquestionably, careers in vehicle maintenance will continue to be a major element in most occupational programs. Teaching of engine mechanics has, more than any other program, capitalized on recent trends toward the development of career ladder curricula and development of sequential learning experiences based on the use of increasingly more complex studies and materials.

The use of electronic ignition systems and computerized engine diagnostic systems has meant that many elements of the curriculum, (and the facilities associated with it), will soon require major revision. Similarly, the potential for the electric or steam-driven vehicle has meant that electricians and plumbers may become the auto mechanics of the future--and such changes must be planned for in a building that will certainly still exist when such systems become realities.

All these influences have contributed to a trend away from programs and facilities designed around the use of cars as the sole educational system and have led to the planning of more flexible-use spaces for free-standing engines, transmission, chassis assemblies and hydraulic systems--whether they are for automobiles, airplanes, or snowmobiles. Similarly, carrels for audio-visual programs or small-system mock-ups have become common for teaching operation theory and repair principles of carburetors, fuel pumps, electrical systems, and the like. In fact, the car can realistically be relegated to a minor status, potentially occupying only twenty to thirty percent of total teaching time and facility space.

The fact that a car can realistically be regulated to a minor status reflects more than a simple redistribution of instructional time in the automotive program. More and more other kinds of engine mechanics and aircraft engine repair, have made inroads into the traditional auto mechanics shop. The trend has had significant consequences in the architectural requirements for vehicle maintenance programs, particularly where the use of a car on a lift has been required less, much of the architectural burden of the high-ceiling facility has been removed. Similarly, the use of simulators and free-standing systems, such as transmissions and chassis assemblies, have drastically altered the need for costly walls that meet the fire code. This shift has led to an increase in space use efficiency (as reflected in a major reduction in the "area per station" requirements in Table 10) and program flexibility. The planning of a mechanics laboratory on this basis also provides greater flexibility in the kinds of specialities that can be developed

In the new mechanics programs the mechanics simulator, trainer, and mock-up areas of the laboratory should represent as much as seventy percent of the student stations and are intended to provide experience in all the basic principles and skills required to tune-up and repair automobile and diesel engines, those for trains and reciprocating aircraft engines.

Initial comprehension of these mechanical skills does not require experience on the actual vehicle and is, in fact, better learned in a classroom situation. Separate spaces in the shop area may be provided for engine tune-up and overhaul, transmission repair, chassis-suspension-brake system repair, and automotive electrical and accessory systems. (Note: None of the spaces for these activities requires a garage facility (high ceiling, etc.) and it may therefore be a single-story area opening off the auto bay area. The extra space above the laboratory areas can be used for storage or for such equipment as driver-training simulators.)

An engine tune-up and test laboratory is provided to teach students the basic skills of engine timing and tune-up, carburetor and fuel-system repair, and other minor mechanical repair operations. Operating mock-ups of free-standing six- and eight cylinder gasoline and diesel engines should be supplied. If provision is to be made for an automotive technology program, this area of the laboratory should also provide for one or more fully instrumented engine/transmission dynamometers. This laboratory can be a multiprogram area with alternate use and storage of automotive, diesel and aircraft engines.

The engine overhaul work stations should consist of heavy-duty metal benches and an adjoining area where engines may be mounted while in use. Engine stands should be movable to allow for the location of a different engine at each station during alternate laboratory periods. Overhaul and repair require some specialized equipment (such as presses and grinders), and there should be access to a milling machine and cylinder-boring machine. This accounts for the large circulation burden provided in Table 10. An area for temporary storage should be provided off to the side.

The transmission area should be designed to lead students to develop the ability to repair automatic transmissions, fluid couplings, torque converters and hydromatics; to develop an understanding of gear ratios and planetary systems, clutches, control mechanisms, electrical and vacuum mechanisms; and to learn about fluids, seals, bearings and hydraulic valves. This area should consist of several automatic and manual transmissions mounted on stands, plus one or more complete chassis and drive-train (engine, transmission, differential, rear axle) systems. If a fully equipped chassis section is needed it can be shared with the adjoining chassis-steering-suspension area. Each student station in this shop will need a heavy-duty metal transmission workbench furnished with compressed air and an electrical outlet. The chassis-steering-suspension area is used to teach the principles of, and repair skills for, manual and power-steering mechanisms, brake- and suspension-system adjustment and wheel alignment, caster and camber adjustment. There should be one or more full chassis front-end assemblies. A workbench near each chassis is needed for tools and parts and an audio-visual teaching system. In addition, carrels or other suitable structured individual system mock-ups of wheel-brake-spring-shock absorber assemblies for the initial study of these systems may be useful.

Small Engine Repair. As an option under the engine mechanics and automotive service program, the small-engine mechanics program is a specialty leading to careers in the maintenance of outboard motors, motorcycles, lawn mowers, snowmobiles, etc.

The small-engine repair shop requires only heavy-duty benches arranged to allow for a cart-mounted gasoline generator, motorcycle, outboard motor or whatever next to it.

Vehicle Garage. The garage "bay" should be a study area planned only for training in those special skills, such as muffler replacement or tire changing, that require the use of a car. Here students can apply the skills developed on simulators and mock-ups to real problems of automotive tune-up and repair. Each bay should provide for up to four students.A comprehensive auto mechanics program should include at least one single, double, and split-post lift and one front-end alignment unit. In advanced programs a one-chassis dynamometer is also desirable. If a service station is included, the auto bays should be adjacent to them.

Service Station. When a service station is to be operated by a school it should offer training in customer relations as well as in mechanics. The service station and office should reproduce their commercial equivalents and the service station should be visible from, and convenient to, entry drives to the school.

Body and Frame. Like auto mechanics, auto-body repair programs have undergone major restructuring in recent years as specialties have developed. Among these are the "glass" men and the seat-cover repairmen. Auto-body repair training also does not require a car. As pointed out earlier, development of basic skill in sheet metal pounding and shaping and in the use of plastics fall into this group. The removal of the car again reduces costs of fire protection.

The auto-body repair shop provides the facilities for students to acquire all the mechanical skill for repair and refinishing and to develop an understanding of the various paints and solvents used in metal finishing. They should also be able to estimate the cost of an auto-body job.

Work in this department ranges from straightening a twisted or bent frame to the final waxing of a repainted fender. Students learn to weld structural members and sheet metal (basic instruction takes place in the related specialty shops), knock dents out of sheet-metal areas, fill ripples and minor dents, sand the surface smooth with machines and by hand, undercoat, spray on a new finish, touch up small areas, sand and rub down a painted finish, repair and repaint fiberglass body sections, and adjust doors and hoods.

In most cases full bays are needed. They can be used in rotation so that they are flexible enough for use in many preliminary experiences leading up to more complicated work. The extensive use of space-sharing program places unusual demands on the laboratory's storage requirements. However, bench space is scarcely ever needed. except for work on repainting or straightening a small part.

TABLE 1 - Space Requirements for the Vehicle Maintenance Cluster

Laboratory	Station	Unit Area	Stations per Unit Area	Circulation Burden	Allocation of Total Class Stations	Remarks
Engine Mechanics	Auto Bays	14 x 25	1-4	25% or 700 s.f. (larger)	50%	Unit area includes allowance for standard workbench (5x5 ft. station). Circulation burden includes a general auto shop allowance for support equipment such as engine analyzer, spark plug cleaner, parts cleaner, etc. (Note: These space allowances are based on individual entry to each bay. See Note a.)
	Service Station	200 s.f.	2-4	-	10%	Plus ¼ acre of adjacent outside space.
	Engine Tune-Up	6 x 8 to 9 x 10	1-2	25%	25%	Station allowance does **not** provide for adjacent workbench.
	Dynamometer	10 x 12	2-4	25 - 80%	(1)	
	Engine Overhaul	8 x 10	1-2	-	25%	Station allowance **includes** workbench. Circulation allowance varies with support machinery.
	Transmission	5 x 6	1	40%	25%	
	Chassis	14 x 20	1-4	25%	25%	Half chassis (i.e., front-end or rear-end) requires half to two-thirds of the unit area.
	Carrels/ Trainers	4 x 6 to 6 x 8	1	25%	10 - 30%	Mock-up carrels and trainers for electrical systems, a/c systems, fuel systems, brake systems, etc.

TABLE 1 (CONTINUED)

Laboratory	Station	Unit Area	Stations per Unit Area	Circulation Burden	Allocation of Total Class Stations	Remarks
Engine Mechanics (Continued)	Small Engine	6 x 10	1-2	50%	Note b	Station allowance includes bench.
	General Circulation	(50 - 100% of total except auto bays)				Applied to each area in a physically subdivided laboratory.
	Storage	(10 - 15% of total)				

Notes: a - Traffic allowance in the garage area should provide a minimum of 15 ft. of clearance between rows of cars for one-way traffic with angled bays. For two-way traffic and/or straight-in parking, a minimum traffic aisle of 25 ft. is recommended. General circulation in the area of engine stands, simulator stations, etc., should represent a 50% burden for a minimum of 5 stations and slide to 10% for 30 or more stations. A general space allowance of 5% of the bay area should be allowed for support equipment, such as static wheel balancers, valve resurfacers, oil cleaning bath, etc.

b - As required by program.

JOB DESCRIPTION

The automotive maintenance and repair person covers a wide range of general and specific skills. There is a general tendency to label all of those envolved in the occupation as "mechanics." For the purposes of a practical educational program that is designed to fill the students needs at whatever level of attainment they chose to seek employment, this occupation should be dealt with in levels of skills. For example, to say that the average student completing a secondary skill development program is prepared as a highly skilled automotive technician would be both a disservice to the student and to the employer. The orientation level program should not attempt to develop any degree of skill in the student. However, the post-secondary technical level program should not only teach the student the highest level of skill attainable but also serve the students technical growth on a continuing basis as technology changes and as the individual's needs become more acute.

OBJECTIVES

Of This Suggested Guide

To furnish to the instructor, planner and counselor a guide from which can be obtained current information on the trade, facility planning, equipment available, and resource information for all levels of occupational instruction in the broad field of auto mechanics maintainance and repair.

For The Total Course

At the period in time when a student has completed all sections of this guide, he will be able to perform to the manufacturer's specifications any task or operation to the point of having a salable skill, or that the student will be employed in the occupation at the time of course completion.

PART A – SUGGESTED ORIENTATION COURSE OUTLINE

SECTION I — Overview of Automotive Industry

A. Learner will be able to list the major business and manufacturing systems in the automotive industry.

B. Learner will be able to describe the flow of materials and resources from raw materials to finished cars.

C. Learner will be able to identify many of the occupations in the automotive industry and give brief job descriptions for each of them.

SECTION II — Fasteners and Couplings

A. Learner will be able to identify names, sizes, and functions of most of the screws, rivets, clamps, and other fasteners used on automobiles, as well as the hoses, tubing and couplings used to interconnect automotive systems, including Auto Body.

SECTION III — Basic Hand Tools

A. Learner will be able to identify names and common user of over 100 basic hand tools used in automotive servicing, including Auto Body.

SECTION IV — Basic Physical Principles

A. Learner will be able to state the basic principles of heat transfer, combustion, mechanical energy, electrical energy, motion, and lubrication

B. Learner will be able to describe the application of the principles above to automotive systems.

SECTION V — Electrical System Fundamentals

A. Learner will be able to describe basic electrical quantities and their application to the control systems in an automobile.

SECTION VI — Fundamentals of Engine Operation

A. Learner will be able to name over 20 major components of an internal combustion engine.

B. Learner will be able to give brief description of each component.

C. Learner will be able to describe the overall operation of an engine.

SECTION VII — Engine Fuel, Lubrication and Cooling Systems

A. Learner will be able to name the major components in the fuel, lubrication, and cooling systems.

B. Learner will be able to give a brief description of the purpose and function of each component.

SECTION VII: Measuring Devices

A. Learner will be able to describe the techniques and problems in taking measurements.

B. Learner will be able to use several of the common measuring devices, such as rules, calipers, and meters.

SECTION IX Operation of Engine Electrical Systems

A. Learner will be able to identify major components of cranking, charging, ignition, and body electrical circuits in an automobile.

B. Learner will be able to give brief descriptions and function of each of the above components.

SECTION X Transmission, Drive Shaft and Axle Operation

A. Learner will be able to name the major components of the drive train system of an automobile.

B. Learner will be able to give brief description of the purpose and function of each of these components.

SECTION XI Suspension System Fundamentals

A. Learner will be able to identify suspension devices and how they function to support an automobile and provide the necessary steering, safety, and comfort conditions.

SECTION XII Safety in the Auto Shop

A. Learner will be able to list all the dangers and safety precautions in an auto shop, especially when using welders, grinders, drills, hoists, battery chargers, tire changing, and other equipment.

SECTION XIII Automotive Tune-Up Procedure

A. Learner will be able to describe the steps required, the equipment and materials needed, the means for testing performance and the safety precautions required to perform a complete automotive tune-up.

SECTION XIV Automotive Trouble-Shooting Procedure

A. Learner will be able to describe the proper steps in analyzing an automobile that has a malfunction.

B. Learner will be able to diagnose probable faults.

C. Learner will be able to identify what tests to make for a wide variety of trouble symptoms.

PART B – SKILL DEVELOPMENT, CHASSIS AND ENGINE MECHANICS OUTLINE

SECTION I Engines

A. Valve and valve trains
B. Piston assemblies and cylinder block
C. Crankshaft
D. Manifolds, (exhaust) heads
E. Crankcase assembly
F. Manifolds, (intake) and heads
G. Electrical generators
H. Ignitions
I. Lighting and signal

SECTION II Fuel System

A. Tank
B. Injector, pump and lines
C. Carburetor and lines

SECTION III Cooling

A. Radiator and cooling jacket
B. Fan and pump
C. Temperature gauge, thermostats, hoses
D. Coolants

SECTION IV Suspension

A. Springs, mounting and shock absorbers
B. Front suspension

SECTION V Power Train

A. Clutch
B. Transmission
C. Drive line
D. Differential and axles

SECTION VI Steering System

A. Steering linkage
B. Gear and column assembly
C. Power unit

SECTION VII Brakes

A. Hydraulic
B. Wheel assembly
C. Parking
D. Power unit

SECTION VIII General Service

A. Body adjustment and alignment
B. Exhaust
C. Wheels, tires

SECTION IX Accessories

A. Windshield wipers
B. Windshield washers
C. Speedometer
D. Radio
E. Climate control system
F. Clock
G. Lighter
H. Power assist units
I. Electronic sensors

SECTION X Customer Relations

A. Personalities
B. Initial contact
C. Service request and customer order forms
D. Dissatisifed customers
E. Character development

PART C – SKILL DEVELOPMENT, AUTO BODY MECHANICS

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A. Modern vehicle design
B. Body parts identification
C. Door construction
D. Interior and hardware trim
E. Seat construction
F. Exterior moldings
G. Glass

SECTION II Hand Tools

A. Screwdrivers
B. Wrenches
C. Units of measurement
D. Driver
E. Pliers
F. Vise grips and clamps
G. Hacksaws
H. Files
I. Cold chisels
J. Punches
K. Snips
L. Twist drills
M. Body-bumping hand tools
N. Hammers
O. Dollies
P. Spoons
Q. Pry bars
R. Body files

SECTION III Body Fastener (See Orientation Section)

A. Types of bolts

SECTION IV Welding

A. Oxygen cylinder
B. Acetylene
C. Regulators
D. Blowpipe or torch
E. Precautions when assembling welding equipment
F Turning on welding units
G. Welding flames
H. Welding position
I. Welding joint design
J. Types of welding
K. Welding procedure
L. Welding sheet metal
M. Plug welder
N. Principles of gas cutting
O. Electric welding
P. Precautions necessary when welding on automobiles

SECTION V Sheet Metal Damage Repair Procedure

A. Hammering techniques
B. Effects of bending on steel
C. Basin hammer and dolly methods used in straightening damaged areas
D. Methods of detecting high and low spots
E. The grinder

SECTION VI Soldering

SECTION VII Expansion, Contraction, Heat Distortion and Shrinking

SECTION VIII Fitting Methods

SECTION XI Frame Straightening Techniques, Suspension System and Steering Principles

SECTION X Plastic Filler and Fiberglass Body Repair

SECTION XI Panel Forming Techniques

SECTION XII Electrical Circuits in Auto Body

SECTION XIII Refinishing Materials

SECTION XIV Surface Preparations

SECTION XV Spray Equipment

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SECTION XVII Exterior and Interior Cleaning

SECTION XVIII Estimating Damage and Public Relations

PART D – AUTOMOTIVE TECHNOLOGY

SECTION I Engine and Chassis Technology

A. High performance engines
B. Blueprinting engines
C. Fuel properties
D. Fuel mixtures
E. Lubricants
F. Material testing
G. Wear tests
H. Fatigue tests
I. Tire tests

SECTION II Body Technology

A. Chassis design
B. Suspension testing
C. Body design
D. Aerodynamics of body styles

PART E – TOOLS

SECTION I Suggested Automotive Mechanics Hand Tools

The following tools are suggested to serve 25 students in a vocational automotive mechanics program. Students should be encouraged to obtain their personal tools as suggested in the student starter kit. However, when this is not feasible, the school should provide the necessary quantity for the class size.

ITEM	DESCRIPTION	QUANTITY
1.	Bolt cutter, 30"	1
2.	3" - C Clamps	2
3.	6" - C Clamps	2
4.	8" - C Clamps	1
5.	10" - C Clamps	1
6.	Calipers, 6" - inside spring nut release, screw thread adjustment	1
7.	Calipers, 6" O.D. spring nut release, screw thread adjustment	1
8.	Chisel and punch set	2 sets
9.	Tap and die machine screw set	1
10.	Tap and die set NF ¼" to ½"	1
11.	Tap and die set NC ¼" to ½"	1
12.	Drill bits, set, 1/16" thru ½" by 64ths, high-speed steel, straight shank	2
13.	Drill bits, set, 0 thru 80, high-speed steel, straight shank	1
14.	Drill bits, set - letter size drill with stand	1
15.	Extension cord, 3 wire 20' sections	3
16.	10" flat bastard, file with handle	3
17.	10" half round bastard, file with handle	3
18.	10" round bastard, file with handle	3
19.	10" hand smooth, file with handle	3
20.	10" mill smooth, file with handle	3
21.	Ignition point, file	6
22.	Regulator point, file	6
23.	Thread file	1
24.	Cylinder dial indicator, gauge	1
25.	Feeler set, flat gauge	6

26.	Feeler set, wire gauge	6
27.	Screw thread gauge	2
28.	Tire gauges, (1 large and 2 small)	3
29.	Hammers, ball pein, 8 oz., 12 oz., 16 oz., 24 oz., 32 oz., 48 oz.	2 each
30	Plastic and soft-face hammer	3
31.	Rubber mallet	1
32.	Sledge, 4 lb.	1
33.	Brake cylinder, hone	2
34.	Deglazer	2
35.	Lining up bar, 8", 12", 16", 24"	1 each
36.	Micrometers, inside diameter, range 1½" to 8"	1 set
37.	Micrometer, outside diameter, sizes 0-1", 1-2", 2-3", 3-4", 4-5"	1 each
38.	1 qt. oil, flexible spout, measure	1
39.	1 gal. oil, flexible spout, measure	1
40.	Piston ring, Compressor	3
41.	Piston ring, Groove Cleaner	3
42.	Piston ring, Remover and installer	3
43.	Thin nose slip joint, 6½" long pliers	3
44.	Thin blunt nose slip joint, 6¾" long pliers	3
45.	Diagonal cutting 7½" long pliers	3
46.	Long needle nose, 6¾" long pliers	3
47.	Curved thin needle nose, 6" long pliers	2
48.	Long reach needle nose, 7¾" long pliers	2
49.	Vise gripes, 7" and 10" pliers	2 each
50.	Hose clamp, pliers	2
51.	Snap ring, standard pliers	4
52.	Snap ring Tru Arc, internal-external, set of 12	1
53.	Water pump, channel locks	3
54.	Puller set	1
55.	Ridge reamer	2
56.	Saw, hand hack, adjustable frame with blades	6
57.	Scale, steel 3'	1
58.	Screw drivers, standard set, 6 pieces	2 sets
59.	Screw drivers, Phillips head set, 6 pieces	2 sets
60.	Screw drivers clutch head attachments, assorted	1
61.	Screw extractor	2
62.	Scratch awl	2
63.	Snips, tin, straight	1
64.	Snips, tin, curved	1
65.	Soldering iron, electric, 200 W.	1
66.	Soldering gun, variable heavy duty	1
67.	Stamps, steel, 3/16" figures 1-0	1
68.	Stamps, steel, 3/16" letters, A to Z	1
69.	Tape, flexible, steel 25'	1
70.	Terminal kit and crimping tool	1
71.	Wrenches, Allen-set	2 sets
72.	Wrenches, box; 6 pt., set	2 sets
73.	Wrenches, box; 12 pt., set	2 sets
74.	Wrenches Drive Adapter: 3/8" female and ½" male	2
75.	Wrench Drive Adapter: 3/8" male and ½" female	2
76.	Wrench Drive Adapter: ½" female and 3/4" male	2
77.	Wrenches, ignition set	3 sets
78.	Wrenches, open end and combination box wrench set: ¼" - 1¼"	2 sets
79.	Wrenches, socket: set, ½" drive, 7/16" thru 1¼" sockets (1 set 6 pts. and 1 set 12 pts.)	1 set each
80.	Wrenches, sockets: set, 3/8" drive socket set, complete	2 sets

81.	Wrenches, sockets: set, 3/4" drive, large sockets, complete	1 set
82.	Wrenches, sockets: set, ¼" drive socket set, complete	2 sets
83.	Wrench, Torque: 0-120 in./lbs., 3/8" drive	2
84.	Wrench, Torque: 0-150 ft./lbs. ½" drive	4
85.	6" pipe wrench	1
86.	10" pipe wrench	1
87.	18" pipe wrench	1
88.	24" pipe wrench	1
89.	Wrench, adjustable set, 4", 6", 8", 10", 12", 20"	1 each
90.	Ark-O-Graph (metal market electric)	1
91.	Grinding wheel dresser	1
92.	Valve Spring Compressor	3
93.	Test Lights - High Voltage	3
94.	Test Lights - Low Voltage	3
95.	Continuity Light	3
96.	Battery jumper cables, heavy duty	1 set
97.	Belt tension gauge	1
98.	Hand lube gun	2
99.	Suction gun	1
100.	Utility chain with hooks, 6' - 5/16" links	2
101.	Engine Sling, Adjustable	1
102.	Flywheel turner	1
103.	Diode tester	1
104.	Diode tool set	1
105.	U-Joint press	1
106.	Wheel lug wrench, X-type	2
107.	Oil cans	12
108.	Chain wrench	1
109.	Oil filter wrench	1
110.	Distributor wrenches, complete set	1
111.	Carburetor - distributor adjusting tool	1
112.	Exhaust pipe expander, adjustable	1
113.	Mirrors, inspection	2
114.	Oil pour spouts	2
115.	Transmission funnels	2
116.	Spring tension gauge	2
117.	Alternator pulley puller	1
118.	Wire brush, ¼" shank	6
119.	Wire brush, hand	6
120.	Parts cleaning brush	6
121.	Brake adjustment spoons	3
122.	Carbon scraper, round	3
123.	Carbon scraper, square	3
124.	Brake bleeder wrenches set	1
125.	Special brake tool set	2
126.	Flexible handle magnets (short and long)	2
127.	Head stand	2
128.	Tire air check	1
129.	Remote starter buttons, heavy duty	1

A SUGGESTED STUDENT STARTER TOOL KIT

The following tools are suggested for the student to purchase for their personal use as a beginning auto mechanic. When this is not feasible, the school should supply the necessary quantity for students to use while in the program.

1. Socket set ½" drive, 3/8" - 1" by 16ths, with 6" and 10" extension, universal joint, 13/16" spark plug socket, speed handle, ratchet, and flex handle
2. Combination box and open end wrench set ¼" - 7/8"
3. Box wrench set, 45 degrees long, 3/8" - 7/8"
4. Screwdriver set, phillips and standard
5. Socket set, 3/8" drive, with 5/8" spark plug socket
6. Slip joint pliers, 8"
7. Channel lock pliers, 9½"
8. Vise grips, 10"
9. Diagonal cutting pliers, 6"
10. Needle nose pliers, 6"
11. Adjustable wrench, 10"
12. Ball pein hammer, 16 oz.
13. Flat blade chisel, ½"
14. Flat blade chisel, 3/4"
15. Starter punch, 5/16"
16. Starter punch, 1/8"
17. Center punch
18. Carbon scraper or putty knife
19. Feeler gauge
20. Ignition point file
21. Tool box or storage chest

SECTION II. Facility Planning

A. Auto Mechanics

Suggested automotive areas that should have consideration as to space allocation are:

1. Auto Service
2. Advance Service
3. Engine Rebuilding
4. Chassis Lab.
5. Air Conditioning
6. Emission and Fuels
7. Classroom and Storage
8. Locker Area
9. Tool Storage
10. Parts Room
11. Customer Waiting, (Optional)
12. Outdoor Storage

There should be no posts in the shop area. The shop should be equipped with two hydraulic hoists, one of each kind, (single or dual center and split); a single drive through aisle is suggested; center trough floor drain, steam cleaner, outside hook-up, electricity, water and compressed air supply at each stall; pull down reel-type trouble lights, under floor exhaust manifold system, outside waste collection and disposal area with underground waste oil storage tank; compressor placed in other than shop area, outside fire and explosion-proof facility for storage of flammable, wheel alignment pit, with work area and rest room in close proximity. Special consideration for auto body shop facilities are: Possibly more outside storage area with screened portion to public view, outside storage for oxygen and acetylene bottles, a shower area in wash room, larger entrance door for damaged cars or trailers or trucks.

Additional consideration should be given to explosion proofing the spray booth and making a more permanent aspect of the basic building facility.

SHOP FACILITY PLANNING EQUIPMENT

(See Space Requirements for Vehicle Maintenance Cluster, p. 7)

Quantity Required	Fix or Move	Description
1	M	500 linear feet of hd. Steel shelving, 14" deep
4	M	Table, folding leg, H.D., formica top, 30" x 72"
24	M	Chair, folding, metal, padded seat and back
1	M	Overhead projector, 10" x 10" aperture
1	M	Hydraulic press, floor model, 50 ton
1	M	Valve refacer, portable cabinet (w/seat refacer)
1	M	10" lathe, metal armature attachment
2	M	Grinder, 10" pedestal type
1	M	Head lamp tester, floor type
1	M	Wheel balancer, dynamic, on car type
1	M	Tire changer, air and electric
1	M	Electric welder, 200 amp AC
1	M	Gas welder, w/welding and cutting accessories, portable
1	M	Battery charger and tester, port.
1	M	Distributor tester
1	M	Universal engine tester and analyzer
1	M	Carburetor analyzer w/all accessories
1	M	Emission tester, infrared w/all accessories
1	M	Spark plug cleaner and tester w/stand
1	M	Floor jack, service, type, portable 4 ton
4	M	Floor jacks, service type, portable 2 ton
1	M	Transmission jack, portable, universal 1 ton
1	M	Mobile crane, portable, 2 ton, w/boom extension
10	M	Work bench, steel top, base storage, 6'
2	M	Write-up desk, standing type, w/cabinet storage
12	M	Safety stands, 2 ton cap.
1	M	Gear oil dispenser, portable, 25 gal., metered
1	M	Chassis lube dispenser, 25 gal., metered, portable
2	M	Waste oil receptacle, 25 gal. capacity, portable
2	M	Parts cleaners, air agitated soak tank
2	F	I-beam rail chain hoist, 2 ton capacity
1	M	Brake bleeding tank with air operated pump
3	M	Impact wrench with attachments
1	M	Air slugger - impact cutter, with attachments
1	M	½" drill, electric, H.D.
2	M	3/8" drills, electric, H.D.
4	M	Engine repair stand with adapters, universal
1	M	Vacuum cleaner with attachments, commercial, 2-½ bushel capacity
1	M	Tap and die set - up to ½" in case
1	M	Battery starter tester
4	M	Tack dwell meter
1	M	Valve guide reamer set, in case
1	M	High pressure hot water cleaner, oil fired
2	M	Storage cabinet for parts

B. Auto Body Shop Equipment

Quantity Required	Fix or Move	Description
1	F	Solid back spray booth, 24' inside depth, proportioned air vapor tight flourescent light fixtures, No. DSA-610
2	M	Infrared panels, portable, 64" x 84" No. IRP-504
1	M	Air compressor, 80 gal. tank
4	M	Spray gun units, suction feed, with six 16 and 32 oz. cups, four 25' sections air line and air regulators
1	M	Air fittings and line for spray area
4	M	General purpose storage cabinet
1	M	Assortment of related hand tools and supplies
1	M	Tablet arm chairs, molded plastic seat and back
1	M	Instructor's desk, double pedestal 60" x 30"
1	M	Desk chair, swivel, arm
2	M	File cabinet, 4 drawer, letter size
1	F	Projection screen, v all mounted, 70" x 70"
1	M	Overhead projector, 10" x 10" aperture
1 lot	M	Steel shelving, with six shelves, 15' x 2' x 7'
2	M	General purpose cabinets
1	M	Vertical box storage rack
1	M	Frame repair system, electric and air operation, No. FM-10
1	M	Frame and body puller system, hydraulic, 10/10/10
3	F	Twin post hoists, air/hydraulic
8	M	Work benches, steel top and cabinet storage, 8' x 30"
1 comp	M	Body work tools; pullers, hand tools, etc.
1 comp	M	Power tools, air operated; drills, sanders, grinders, chisels, etc.
2	M	Pedestal grinder, 8"
1	M	Drill press, variable speed, 20"
4	M	General purpose cabinet, storage
1 comp	M	Electric hand tools; shear, metal saws, etc.
1	M	Steam cleaner, oil fired with accessories
1	M	Parts cleaning tank, air agitated soak tank
2	M	Gas welding and cutting outfits
1	M	Damage dozer
2	M	Panel cutter, air
3	M	Impact wrench, ½", air
1	M	½" drill, air
2	M	3/8" drill, air
1	M	Puller set, universal
4	M	Grinder, 7" with disc, pneumatic, portable
2	M	Buffer, low rpm, 6" wheel
4	M	Oscillating sander, pneumatic, 6", portable
1	M	Windshield storage rack, 8 unit capacity
1	M	Standing shop desk, cabinet storage
2	M	Twin saddle jacks, 2 ton capacity
12 pair	M	Safety stands, 2 ton capacity
1	M	Wheel balancer, dynamic type
1	M	Alignment unit, floor type, with all accessories
1	M	Boom type crane, portable, 2000 lb. capacity
1	M	Front/rear end lift, portable, 3000 lb. capacity
2	M	Chassis jack, portable, 2 ton capacity
1	M	Redi-spot welding fun, 3 heat settings

C. Optional Auto Mechanics Equipment

1	Mobile crane, 1 ton
1	Brake drum or disc lather with shoe grinder

1	Cylinder Boring machine/portable
1	Crankshaft bearing grinder
1	Crankshaft and cylinder alignment gauge
1	Milling machine
1	Crankshaft grinder
1	Camshaft grinder
1	Surface hardening furnace
1	Reamer, up to 3"
1	Distributor machine
1	Emission tester infrared with accessories
1	Air chisel and hammer set complete
1	Set of cylinder hones
1	Outside micrometer, up to 4"
1	Inside micrometer, up to 4"
1	Air conditioning servicing set

PART F – REFERENCE MATERIALS

1. "A Guide For Planning Facilities for Occupational Preparation Programs in Automotive Services" - The Center for Vocational and Technical Education, The Ohio State University, 1900 Kenny Road, Columbus, Ohio 43210

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3. Snap-On-Tool "Educational Service Program for Auto Mechanics" Kenosha, Wisconsin 53140

4. Automotive Engine Specialist, a suggested guide for a training course, OE 87056, 1971, U. S. Department of Health, Education and Welfare, Superintendent of Documents - Catalog No. HE 5.287-87056, U. S. Government Printing Office, Washington, D.C. 20402 Price, $0.60

5. "Standards for Automotive Service Institutions in Secondary Schools" - Automobile Manufacturers' Association, Incorporated, 320 New Center Building, Detroit, Michigan

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9. Blanchard, Harold F. and Ralph Kitchen, **Auto Engines and Electrical Systems,** Motor, 250 West 55th Street, New York, New York 10036

10. **Brake School Manual,** Barnett Equipment Co., 21st and Cass Avenue, St. Louis, Missouri 63106

11. **Brake Service,** Ammco Tool, Inc., Commonwealth Avenue, North Chicago, Illinois 60064

12. Brown, Walter C., **Basic Mathematics,** Goodheart-Wilcox Co., 18250 Harwoode Avenue, Homewood, Illinois 60430, 1973

13. Bricker, Frederick, **Automobile Guide,** Howard W. Sams and Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268

14. **Carter Carburetor Manual,** Carter Carburetor, Education Dept., 2840 North Spring, St. Louis, Missouri 63107

15. **Chek-Chart Car Service Manual,** The Chek-Chart Corporation, 222 West Adams St., Chicago, Illinois 60606

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17. Dwiggins, Boyce H., **Automotive Air Conditioning,** Delmar Publishing Company, Inc., Mountainview Avenue, Albany, New York 12205, 1970

18. Dwiggins, Boyce H., **Automotive Steering Systems,** Delmar Publishing Company, Inc., Mountainview Avenue, Albany, New York 12205, 1968

19. **Engine Service Bearing Manual,** Federal-Mogul Corp., 11031 Shoemaker Ave., Detroit, Michigan 48213

20. Frazer, Irving, **Automotive Brakes and Power Transmission Systems,** American Technical Society, 848 E. 58th Street, Chicago, Illinois 60637

21. Frazer, Irving, **Automotive Electrical Systems,** American Technical Society, 848 E. 58th Street, Chicago, Illinois 60637

22. Frazer, Irving, **Automotive Fuel and Ignition Systems,** American Technical Society, 848 E. 58th Street, Chicago, Illinois 60637

23. **Front Wheel Alignment,** Ammco Tool Inc., Commonwealth Avenue, North Chicago, Illinois 60064

24. Frost, James V., **Fundamentals of Automotive Mechanics,** John Wiley & Son, Inc., 605 Third Avenue, New York, New York 10016

25. **General Repair Tools,** Delmar Publishing Co., Inc., Mountainview Avenue, Albany, New York 12205

26. **Glen Mitchell Manuals (Vol. I, II, III),** National Automotive Service Inc., P.O. Box 10465, San Diego, California 92110

27. Glenn, Harold T., **Automechanics,** Charles A. Bennett Co. Inc., 237 North Monroe Street, Peoria, Illinois, 1969

28. Jensen, L. E. and Brazin, **Related Science Automotive Trades,** Delmar Publishing Co. Inc., Mountainview Avenue, Albany, New York 12205

29. Jensen, Louis E., **Automotive Drawing Interpretation,** Delmar Publishing Inc., Mountainview Avenue, Albany, New York 12205 1970

30. Kuns, Ray F., **Auto Mechanics** (Set of 5), Bruce Publishing Co., 400 North Broadway, Milwaukee, Wisconsin 53201

31. **Motor, Air Conditioner Service Manual,** Motor Book Department, 250 West 55th Street, New York, New York 10019

32. **Motor's Auto Engines And Electrical Systems,** Motor Book Department, 250 West 55th Street, New York, New York 10019

33. **Motor's Automatic Transmissions,** Motor Book Department, 250 West 55th Street, New York, New York 10019

34. **Motor's Auto Repair Manual** Motor Book Dept., 250 West 55th Street, New York, New York 10019

35. **Motor's Flat Rate Manual,** Motor Book Dept., 250 West 55th Street, New York, New York 10019

36. **Motor's Truck Repair Manual,** Motor Book Dept., 250 West 55th Street New York, New York 10019

37. **Motor's Vacuum and Wiring Diagrams,** Motor Book Department, 250 West 55th Street, New York, New York 10019

38. Murphy, Paula, ed., **Chilton's Auto Repair Manual,** Chilton Publishing Company, 227 South 6th Street, Philadelphia, Pa. 19106 1973

39. Olivo, C. Thomas, **Basic Mathematics Simplified** (Combined Ed.), Delmar Publications, Inc., Mountainview Avenue, Albany, New York 12205, 1972

40. Olive, C. Thomas and Wayne, **Fundamentals of Applied Physics,** Delmar Publishers, Inc., Albany, New York 12205

41. **Practical Problems in Math - Automotive Trades,** Delmar Publishing Co., Inc.. Mountainview Avenue, Albany, New York 12205

42. Ritchen, Ralph, **Motor's Flat Rate and Parts Manual,** Motor Publishing Company, West 55th Street, New York, New York, 1969

43. **Rochester Carburetor Manual,** Rochester Products, United Motor Service, General Motors Corp., Detroit, Michigan 48202

44. Sargent, Robert L., **Automobile Sheetmetal Repairs,** Chilton Publishing Company 401 Walnut Street, Philadelphia, Pa. 19106 1969

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51. Wetzel, Guy F., **Automotive Diagnosis and Tune-Ups,** McKnight and McKnight Publishing Co., U.S. Route 66 at Towanda Ave., Bloomington, Illinois 61701

52. **Wheel and Steering Alignment Technical Manual** Bear Mfg. Division, 1305 S. Cedar Street, Lansing, Michigan 48804

PERIODICALS

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2. **Motor Service,** Hunter Publishing Co., 205 West Monroe Street, Chicago, Illinois 60606

3. **Motor Age,** Chilton Company, Chestnut and 56th Streets, Philadelphia, Pennsylvania 19139

4. **Commercial Car Journal** (CCJ), Chilton Company, Chestnut and 56th Streets, Philadelphia, Pennsylvania 19139

5. **Motor Trend,** Motor Trend, 8490 Sunset Blvd., Los Angeles, California 90069

6. **Shop Manuals** - Cars and Trucks, American Motors Corporation, Detroit, Mich.

7. **Shop Manuals** - Cars and Trucks, Chrysler Corporation, Detroit, Michigan.

8. **Shop Manuals** - Cars and Trucks, Ford Motor Company, Dearborn, Michigan

9. **Shop Manuals** - Cars and Trucks, General Motors Corporation, Detroit, Mich.

10. **Shop Manuals** - Foreign Car Manufacturing Companies

11. **Tool Catalogs** - local, jobbers, supplies, and hardware company

GENERAL REFERENCE MATERIAL

The following references are intended to be used as general references for the entire program in Auto Mechanics. They might be considered as suggested textbooks. The material is broad in coverage and, in general, covers most of the items in the outline. These materials are not included in the bibliography listed at the end of the outline.

Your Automobile	Socony Vacuum Oil Co., 150 E. 42nd St., New York 17, N.Y.
Motor's Auto Repair Manual	Motor 250 W. 55th St., New York 19, N.Y.
Automotive Service Management C.F. Packer	Goodheart-Wilcox Co., Inc. 1322 S. Wabash Ave., Chicago 5, Illinois
Automotive Essentials Kuns	Bruce Publishing Co., 400 N. Broadway Milwaukee 1, Wisc.
Chilton's Automobile Repair Manual and Job Sheets Vol. 1 Bostwick-Barr	Chilton Co., Inc. 56th and Chestnut St. Philadelphia, Pa.

1. American Brake Block Division, American Brake Shoe Co., **Brake Service Guide**, 4600 Merritt Ave., Detroit 9, Michigan.

2. Automotive Electric Association, **Automotive Electrical System, Vol. I**, 16223 Meyers, Detroit 25, Michigan.

3. Automotive Electric Association, **A.E.Z. Tune-Up System, Charts & Wiring Diagrams**, 16223 Meyers, Detroit 35, Michigan.

4. Automotive Electric Association, **Automotive Fuel Systems Vol. 2**, 16223 Meyers, Detroit 35, Michigan.

5. A. C. Spark Plug Division, General Motors Corp., A. C. **Fuel Pump Shop Manual**, Education Relations, Public Relations Dept., Detroit 2, Michigan.

6. A. C. Spark Plug Division, General Motors Corp., **ABC of Hand Tools**, Educational Relations, Public Relations Dept., Detroit 2, Michigan.

7. Barrett Equipment Co., **Brake School Manual**, 21st & Cass Ave., St. Louis 6, Mo.

8. Bean Mfg. Division, Form Machine & Chemical Corp, **Wheel & Steering Alignment Technical Manual**, 1035 S. Cedar St., Lansing 4, Michigan.

9. Bear Mfg. Co., **Principles of Wheel Alignment**, 2016 Fifth Ave., Rock Island, Ill.

10. Bee Line Co., **Ball-Joint Suspension Overhaul**, Box 569, Davenport, Iowa.

11. Bendix Products Division, Stromberg Carburetor, **Automotive Vacuum Brakes**, South Bend, Indiana.

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16. Carter Carburetor, Education Dept., **Carter Carburetor Manual**, 2840 N. Spring, St. Louis 7, Mo.

17. Chrysler Corp. Education Service, Public Relations Dept., **Power Steering**, P.O. Box 1919, Detroit, Michigan.

18. Crouse, William H., **Automotive Chassis, Body & Work Book**, McGraw-Hill Publishing Co., 330 W. 42nd St., New York, N.Y.

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25. Delco-Remy Division, General Motors Corp., **Electrical Equipment,** (DR-324) Anderson, Indiana.

26. Delco-Remy Division, General Motors Corp., **Fundamentals of Electricity and Magnetism,** (DR-5133A) Anderson, Indiana.

27. Delco-Remy Division, General Motors Corp., **Generators** (DR-5133E) Anderson, Indiana.

28. Delco-Remy Division, General Motors Corp., **Heavy Duty Generator Regulators,** (DR-5133G) Anderson, Indiana.

29. Delco-Remy Division, General Motors Corp., **Standard Duty Generator Regulators,** (DR-5133F) Anderson, Indiana.

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31. Delco-Remy Division, General Motors Corp., **The Ignition System,** (DR-5133D) Anderson, Indiana.

32. Delco-Remy Division, General Motors Corp., **12 Volt Electrical Equipment,** (DR-5210) Anderson, Indiana.

33. Dell, Howard, Stevenson, **Brake Work for Automobile Mechanics,** Delmar Publishing Co., Inc. Albany 5, N.Y. (1948)

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60. Russell Mfg. Co., **Clutch Troubles & Their Cures**, Middletown, Conn.

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62. Thompson Products Co., **Automotive Transmissions** (TROOOML) 2209 Ashland Rd., Cleveland 3, Ohio.

63. Willard Storage Battery Division, **A.A.B.M. Battery Service Manual**, 246-286 E. 131st St., Cleveland, Ohio.

AUTO MECHANICS

PART G – INSTRUCTIONAL AIDS

Title of Instructional Aids	Source of Instructional Aids
Film Strips	
Lucky Dollar	Chrysler Corp., Ross Roy, Inc.
Keep Your Promise	Chrysler Corp., Ross Roy, Inc.
Up-To-The-Minute Service Tips	Chrysler Corp., Ross Roy, Inc.
Hydraguide Power Steering	Chrysler Corp., Ross Roy, Inc.
The Man Behind the Dollar	Chrysler Corp., Ross Roy, Inc.
Propeller Shaft & Universal Joint Service	Chrysler Corp., Ross Roy, Inc.
Electrical Tests	Chrysler Corp., Ross Roy, Inc.
The 12-Volt Electrical System	Chrysler Corp., Ross Roy, Inc.
Sure-Grip Differential	Chrysler Corp., Ross Roy, Inc.
Tires and Wheels	Chrysler Corp., Ross Roy, Inc.
Universal Joints & Propeller Shafts	Chrysler Corp., Ross Roy, Inc.
Automotive Electricity	Chrysler Corp., Ross Roy, Inc.
Transmission Maintenance	Chrysler Corp., Ross Roy, Inc.
The New Three Platform Brakes	Chrysler Corp., Ross Roy, Inc.
The New AFB Carburetor	Chrysler Corp., Ross Roy, Inc.
Constant-Control Power Steering	Chrysler Corp., Ross Roy, Inc.
Torqueflight Service Tips	Chrysler Corp., Ross Roy, Inc.
Power Steering and Carburetor Service	Chrysler Corp., Ross Roy, Inc.
The Four-Barrel Carburetor	Chrysler Corp., Ross Roy, Inc.
The V-8 Pressure Cooling System	Chrysler Corp., Ross Roy, Inc.
The New Plymouth V-8 Engine	Chrysler Corp., Ross Roy, Inc.
The Center Plane Brake	Chrysler Corp., Ross Roy, Inc.
The Imperial & Cadillac 60 Special	Chrysler Corp., Ross Roy, Inc.
Torqueflight Transmission Service	Chrysler Corp., Ross Roy, Inc.
Powerflight Transmission Maintenance 1-2-3	Chrysler Corp., Ross Roy, Inc.
Powerflight Transmission Maintenance 3-2-1	Chrysler Corp., Ross Roy, Inc.
Power Steering	Chrysler Corp., Ross Roy, Inc.
The Three Speed Automatic Transmission	Chrysler Corp., Ross Roy, Inc.
Powerflight Automatic Transmission	Chrysler Corp., Ross Roy, Inc.
Service Tips Total Contact Brakes	Chrysler Corp., Ross Roy, Inc.
Latest Tips on Powerflight	Chrysler Corp., Ross Roy, Inc.
Powerflight Transmission Service	Chrysler Corp., Ross Roy, Inc.
Hardtop Door and Window Adjustment	Chrysler Corp., Ross Roy, Inc.
Carburetor and Fuel Gauge Service	Chrysler Corp., Ross Roy, Inc.
No Two Ways About It	FoMoCo - Wixlding Picture Prod.
Overdrive Operation and Service	FoMoCo - Wixlding Picture Prod.
Detour	FoMoCo - Wixlding Picture Prod.
Servicing the Single Barrel Carburetor	FoMoCo - Wixlding Picture Prod.
The Power of Truck Prospecting	FoMoCo - Wixlding Picture Prod.
Accessories Opportunity	FoMoCo - Wixlding Picture Prod.
Basic Transmission	FoMoCo - Wixlding Picture Prod.
The Meaning of FoMoCo	FoMoCo - Wixlding Picture Prod.
Servicing the Car Rear Axle	FoMoCo - Wixlding Picture Prod.
Dual Carburetor Service	FoMoCo - Wixlding Picture Prod.
Facts About Storage Batteries	T.F.T. Training Film Inc.
Champion Spark Plugs	Champion Corp., Florez Inc.

Instructional Aids (con'd)

Title of Instructional Aids	Source of Instructional Aids
Films	
ABC of the Automobile Engine	G.M.C. Film Library G.M. Building, Detroit, Michigan
ABC of the Diesel Engine	G.M.C. Film Library
ABC of Internal Combustion	G.M.C. Film Library
ABC of Jet Propulsion	G.M.C. Film Library
ABC of Hand Tools - Part I	G.M.C. Film Library
ABC of Hand Tools - Part II	G.M.C. Film Library
Firebird III	G.M.C. Film Library
Milestones to Safe Driving	G.M.C. Film Library
More Power for You	G.M.C. Film Library
Oil Films in Action	G.M.C. Film Library
Safe as You Think	G.M.C. Film Library
Service Procedure for Ball Bearings	G.M.C. Film Library
Temperatures Made to Order	G.M.C. Film Library
Tomorrow's Drivers	G.M.C. Film Library
Up From Clay	G.M.C. Film Library
Wanted--Man Alive	G.M.C. Film Library
We Drivers	G.M.C. Film Library
Where Mileage Begins	G.M.C. Film Library
Your Safety First	G.M.C. Film Library
The Rouge	G.M.C. Film Library
	Ford Motor Co. Film Library Dearborn, Michigan
An Equation for Progress	Ford Motor Co. Film Library
This is Aeronutronic	Ford Motor Co. Film Library
Auto Race--1909	Ford Motor Co. Film Library
The American Road	Ford Motor Co. Film Library
The Smith System of Safe Driving	Ford Motor Co. Film Library
Driving the Super Highways	Ford Motor Co. Film Library
Highway Driving	Ford Motor Co. Film Library
Birth of an Oil Field	Shell Oil Co., 624 S. Michigan Ave. Chicago 5, Illinois
Atomization	Shell Oil Co., Chicago, Illinois

Records

One record for each one of the strip film listed in the strip film section. The records are listed under the same title as the strip film.

Charts

How a Car is Assembled	Ford Motor Co., Public Relations Staff, Dearborn, Michigan
Average Stopping Distance	Ford Motor Co.
The Fuel System	G.M.C., Public Relations Staff Detroit, Michigan
The Four Cycle Engine	G.M.C.
Transmission System	G.M.C.
Rear Axle System	G.M.C.
Steering System	G.M.C.
Brake System	G.M.C.
Electrical System	G.M.C.

Instructional Aids (con'd)

Title of Instructional Aids	Source of Instructional Aids
Field Trips	
Ford Motor Company Engine Plant	Berea, Ohio
G.M.C. Chevrolet Transmission Plant	Parma, Ohio
G.M.C. Stamping Plant	Mansfield, Ohio
Ford Motor Company Forge Plant	Canton, Ohio
Hercules Motor Company	Canton, Ohio
Timken Roller Bearing Company	Canton, Ohio
Goodyear Tire & Rubber Company	Akron, Ohio
Firestone Tire & Rubber Company	Akron, Ohio
Monarch Tire & Rubber Company	Hartville, Ohio
Resource People	
Ford Motor Company	
General Motors Corporation	
Chrysler Corporation	
Willys Motors	
American Motors Corporation	
International Harvester Corporation	